

humans, cattle, pigs, mice, rabbits, and sheep (Zanetti *et al.*, *FEBS Lett.* 374:1, 1995), vertebrate defensins, such as human neutrophil defensins [HNP 1-4], paneth cell defensins of mouse and human small intestine (Oulette and Selsted, *FASEB J.* 10:1280, 1996; Porter *et al.*, *Infect. Immun.* 65:2396, 1997), vertebrate β -defensins, such as HBD-1 of human epithelial cells (Zhao *et al.*, *FEBS Lett.* 368:331, 1995), HBD-2 of inflamed human skin (Harder *et al.*, *Nature* 387:861, 1997), bovine β -defensins (Russell *et al.*, *Infect. Immun.* 64:1565, 1996), plant defensins, such as Rs-AFP1 of radish seeds (Fehlbaum *et al.*, *J. Biol. Chem.* 269:33159, 1994), α - and β -thionins (Stuart *et al.*, *Cereal Chem.* 19:288, 1942; Bohlmann and Apel, *Annu. Rev. Physiol. Plant Mol. Biol.* 42:227, 1991), γ -thionins (Broekaert *et al.*, *Plant Physiol.* 108:1353, 1995), the anti-fungal drosomycin (Fehlbaum *et al.*, *J. Biol. Chem.* 269:33159, 1994), apidaecins, produced by honey bee, bumble bee, cicada killer, hornet, yellow jacket, and wasp (Casteels *et al.*, *J. Biol. Chem.* 269:26107, 1994; Levashina *et al.*, *Eur. J. Biochem.* 233:694, 1995), cathelicidins, such as indolicidin from bovine neutrophils (Falla *et al.*, *J. Biol. Chem.* 277:19298, 1996), bacteriocins, such as nisin (Delves-Broughton *et al.*, *Antonie van Leeuwenhoek J. Microbiol.* 69:193, 1996), and the protegrins and tachyplesins, which have antifungal, antibacterial and antiviral activities (Tamamura *et al.*, *Biochim. Biophys. Acta* 1163:209, 1993; Aumelas *et al.*, *Eur. J. Biochem.* 237:575, 1996; Iwanga *et al.*, *Ciba Found. Symp.* 186:160, 1994). Illustrative cationic peptides are listed in Table 1.

TABLE 1

ILLUSTRATIVE CATIONIC PEPTIDES**

Group Name	Peptide	Sequence	SEQ ID	Reference*
Abaecins	Abaecin	YVPLPNVPQGRPFPTF PGQGPFNPKIKWPQGY	<u>37</u>	Casteels <i>et al.</i> (1990)
Andropins	Andropin	VFIDILDKVENAIHNAAQ VGIGFAKPFKLNPK	<u>38</u>	Samakovlis <i>et al.</i> (1991)
Apidaecins	Apidaecin IA	GNNRPVYIPQRPHPRI	<u>39</u>	Casteels <i>et al.</i> (1989)
	Apidaecin IB	GNNRPVYIPQRPHPRL	<u>40</u>	Casteels <i>et al.</i> (1989)
	Apidaecin II	GNNRPIYIPQRPHPRL	<u>41</u>	Casteels <i>et al.</i> (1989)
AS	AS-48	7.4 kDa		Galvez <i>et al.</i> (1989)
Bactenecins	Bactenecin	RLCRIVVIRVCR	<u>42</u>	Romeo <i>et al.</i> (1988)

Group Name	Peptide	Sequence	SEQ ID	Reference*
Bac	Bac5	RFRPPPIRPPPIRPPFYPPFRPPPIRPPPI FPPPIRPPFRPPLRFP	<u>43</u>	Frank <i>et al.</i> (1990)
	Bac7	RRIRPRPPRLPRPRRPLPFPRPGP RPIPRPLPFPRPGPRPIPRPLPFPRP GPRPIPRP	<u>44</u>	Frank <i>et al.</i> (1990)
Bactericidins	Bactericidin B2	WNPFKELERAGQVRDAVISAA PAVATVGQAAAIARG*	<u>45</u>	Dickinson <i>et al.</i> (1988)
	Bactericidin B-3	WNPFKELERAGQVRDAIISAGP AVATVGQAAAIARG	<u>46</u>	Dickinson <i>et al.</i> (1988)
	Bactericidin B-4	WNPFKELERAGQVRDAIISAAP AVATVGQAAAIARG*	<u>47</u>	Dickinson <i>et al.</i> (1988)
	Bactericidin B-5P	WNPFKELERAGQVRDAVISAA AVATVGQAAAIARGG*	<u>48</u>	Dickinson <i>et al.</i> (1988)
Bacteriocins	Bacteriocin C3603	4.8 kDa		Takada <i>et al.</i> (1984)
	Bacteriocin IY52	5 kDa		Nakamura <i>et al.</i> (1983)
Bombinins	Bombinin	GIGALSAKGALKGLAKGLAZHF AN*	<u>49</u>	Csordas and Michl (1970)
	BLP-1	GIGASILSAGKSALKGLAKGLAE HFAN*	<u>50</u>	Gibson <i>et al.</i> (1991)
	BLP-2	GIGAILSAGKSALKGLAKGLAE HFAN*	<u>51</u>	Gibson <i>et al.</i> (1991)
Bombolitins	Bombolitin BI	IKITMLAKLGKVLAVH*	<u>52</u>	Argiolas and Pisano (1985)
	Bombolitin BII	SKITDILAKLGKVLAVH*	<u>53</u>	Argiolas and Pisano (1985)
BPTI	Bovine Pancreatic Trypsin Inhibitor (BPTI)	RPDFCLEPPYTGPCKARIIRYFYFN AKAGLCQTFVYGGCRAKRNNF KSAEDCMRTCGGA	<u>54</u>	Creighton and Charles (1987)
Brevinins	Brevinin-1E	FLPLLAGLAANFLPKIFCKITRKC	<u>55</u>	Simmaco <i>et al.</i> (1993)
	Brevinin-2E	GIMDTLKNLAKTAGKGALQSLL NKASCKLSGQC	<u>56</u>	Simmaco <i>et al.</i> (1993)
Cecropins	Cecropin A	KWKLFKKIEKVGQNIRDGIKAG PAVAVVGQATQIAK*	<u>57</u>	Gudmundsson <i>et al.</i> (1991)
	Cecropin B	KWKVFKKIEKMGRNIRNGIVKA GPAIAVLGEAKAL*	<u>58</u>	Xanthopoulos <i>et al.</i> (1988)
	Cecropin C	GWLKKLGKRIERIGQHTRDATIQ GLGIAQQAANVAATARG*	<u>59</u>	Tryselius <i>et al.</i> (1992)
	Cecropin D	WNPFKELKVGQVRDAVISAG PAVATVAQATALAK*	<u>60</u>	Hultmark <i>et al.</i> (1982)
	Cecropin P ₁	SWLSKTAKKLENSAKKRISERIA IAIQGGPR	<u>61</u>	Lee <i>et al.</i> (1989)
Charybdtoxins	Charybdtoxin	ZFTNVSCTTSKECWSVCQLHN TSRGKCMNKKCRCYS	<u>62</u>	Schweitz <i>et al.</i> (1989)
Coleopterics	Coleopterisin	8.1 kDa		Bulet <i>et al.</i> (1991)
Crabrolins	Crabrolin	FLPLILRKIVTAL*	<u>63</u>	Argiolas and Pisano (1984)
α -Defensins	Cryptdin 1	LRDLVCYCRSRGCKGRERMNGT CRKGHLTYLCCR	<u>64</u>	Selsted <i>et al.</i> (1992)
	Cryptdin 2	LRDLVCYCRTRGCKRRERMNGT CRKGHLMYTLCCR	<u>65</u>	Selsted <i>et al.</i> (1992)
	MCPI	VVCACRRALCLPRERRAGFCRIR GRIHPLCCRR	<u>66</u>	Selsted <i>et al.</i> (1983)

Group Name	Peptide	Sequence	SEQ ID	Reference*
	MCP2	VVCACRRALCLPLERRAGFCR IRGRIHPLCCRR	<u>67</u>	Ganz <i>et al.</i> (1989)
	GNCP-1	RRCICTTRTCRFPYRRLGTCIF QNRVYTFCC	<u>68</u>	Yamashita and Saito (1989)
	GNCP-2	RRCICTTRTCRFPYRRLGTCLF QNRVYTFCC	<u>69</u>	Yamashita and Saito (1989)
	HNP-1	ACYCRIPACIAGERRYGTICIYQ GRLWAFCC	<u>70</u>	Lehrer <i>et al.</i> (1991)
	HNP-2	CYCRIPACIAGERRYGTICIYQG RLWAFCC	<u>71</u>	Lehrer <i>et al.</i> (1991)
	NP-1	VVCACRRALCLPRERRAGFCR IRGRIHPLCCRR	<u>72</u>	Ganz <i>et al.</i> (1989)
	NP-2	VVCACRRALCLPLERRAGFCR IRGRIHPLCCRR	<u>73</u>	Ganz <i>et al.</i> (1989)
	RatNP-1	VTICYCRTRCGFRERLSGACG YRGRIYRLCCR	<u>74</u>	Eisenhauer <i>et al.</i> (1989)
	RatNP-2	VTICYCRSTRCGFRERLSGACG YRGRIYRLCCR	<u>75</u>	Eisenhauer <i>et al.</i> (1989)
β -Defensins	BNBD-1	DFASCHTNGGICLPNRCPGHM IQIGICFRPRVKCCRSW	<u>76</u>	Selsted <i>et al.</i> (1993)
	BNBD-2	VRNHVTCRINRGFCVPIRCPGR TRQIGTCFGPRIKCCRSW	<u>77</u>	Selsted <i>et al.</i> (1993)
	TAP	NPVSCVRNKGICVPIRCPGSM KQIGTCVGRAVKCCRKK	<u>78</u>	Diamond <i>et al.</i> (1991)
Defensins-insect	Sapecin	ATCDLLSGTGINSACAAHCL LRGNRGGYCNGKAVCVCRN	<u>79</u>	Hanzawa <i>et al.</i> (1990)
	Insect defensin	GFGCPLDQMQRHRCQTITGR SGGYCSGPLKLTCTCYR	<u>80</u>	Bulet <i>et al.</i> (1992)
Defensins-scorpion	Scorpion defensin	GFGCPLNQGACHRHCRSIRRR GGYCAGFFKQTCTCYRN	<u>81</u>	Cociancich <i>et al.</i> (1993)
Dermaseptins	Dermaseptin	ALWKTMLKKLGTMALHAGK AALGAADTISQTQ	<u>82</u>	Mor <i>et al.</i> (1991)
Diptericins	Diptericin	9 kDa		Reichhardt <i>et al.</i> (1989)
Drosocins	Drosocin	GKPRPYSPRPTSHPRPIRV	<u>83</u>	Bulet <i>et al.</i> (1993)
Esculentins	Esculentin	GIFSKLGRKKIKNLLISGLKNV GKEVGMDVVRTGIDIAGCKIK GEC	<u>84</u>	Simmaco <i>et al.</i> (1993)
Indolicidins	Indolicidin	ILPWKWPWWPWRR*	<u>85</u>	Selsted <i>et al.</i> (1992)
Lactoferricins	Lactoferricin B	FKCRRWQWRMKKLGAPSITC VRRAF	<u>86</u>	Bellamy <i>et al.</i> (1992b)
Lantibiotics	Nisin	ITSISLCTPGCKTGALMGCNM KTATCHCSIHVSK	<u>87</u>	Hurst (1981)
	Pep 5	TAGPAIRASVKQCQKTLKATR LFTVSCGKNGCK	<u>88</u>	Keletta <i>et al.</i> (1989)
	Subtilin	MSKFDDFDLDVVKVSKQDSKI TPQWKSESLCTPGCVTGALQT CFLQTLTCNCKISK	<u>89</u>	Banerjee and Hansen (1988)
Leukocins	Leukocin A-val 187	KYYGNGVHCTKSGCSVNWGE AFSAGVHRLANGNGFW	<u>90</u>	Hastings <i>et al.</i> (1991)
Magainins	Magainin I	GIGKFLHSAGKFGKAFVGEIM KS*	<u>91</u>	Zasloff (1987)

Group Name	Peptide	Sequence	SEQ ID	Reference*
	Magainin II	GIGKFLHSAKKFGKAFVGEIMNS*	<u>92</u>	Zasloff (1987)
	PGLa	GMASKAGAIAGKIAKVALKAL*	<u>93</u>	Kuchler <i>et al.</i> (1989)
	PGQ	GVLSNVIGYLKKLGTGALNAV LKQ	<u>94</u>	Moore <i>et al.</i> (1989)
	XPF	GWASKIGQTLGKIAKVGLKE LIQPK	<u>95</u>	Sures and Crippa (1984)
Mastoparans	Mastoparan	INLKALAALAKKIL*	<u>96</u>	Bernheimer and Rudy (1986)
Melittins	Melittin	GIGAVLKVLTTGLPALISWIK RKRQQ	<u>97</u>	Tosteson and Tosteson (1984)
Phormicins	Phormicin A	ATCDLLSGTGINHSACAAHCL LRGNRGGYCNGKGVCVCRN	<u>98</u>	Lambert <i>et al.</i> (1989)
	Phormicin B	ATCDLLSGTGINHSACAAHCL LRGNRGGYCNRKGVCVCRN	<u>99</u>	Lambert <i>et al.</i> (1989)
Polyphemusins	Polyphemusin I	RRWCFRVCYRGFCYRKCR*	<u>100</u>	Miyata <i>et al.</i> (1989)
	Polyphemusin II	RRWCFRVCYKGFCYRKCR*	<u>101</u>	Miyata <i>et al.</i> (1989)
Protegrins	Protegrin I	RGGRLCYCRRRFCVCVGR	<u>102</u>	Kokryakov <i>et al.</i> (1993)
	Protegrin II	RGGRLCYCRRRFCICV	<u>103</u>	Kokryakov <i>et al.</i> (1993)
	Protegrin III	RGGGLCYCRRRFCVCVGR	<u>104</u>	Kokryakov <i>et al.</i> (1993)
Royalisins	Royalisin	VTCDLLSFKGQVNSACAAN CLSLGKAGGHCEKGVCICRK TSFKDLWDKYF	<u>105</u>	Fujiwara <i>et al.</i> (1990)
Sarcotoxins	Sarcotoxin IA	GWLKKIGKKIERVGQHTRDA TIQGLGIAQQAANVAATAR*	<u>106</u>	Okada and Natori (1985b)
	Sarcotoxin IB	GWLKKIGKKIERVGQHTRDA TIQVIGVAQQAANVAATAR*	<u>107</u>	Okada and Natori (1985b)
Seminal plasmins	Seminalplasmin	SDEKASPDKHHRFSLRYAKL ANRLANPKLLETFLSKWIGDR GNRSV	<u>108</u>	Reddy and Bhargava (1979)
Tachyplesins	Tachyplesin I	KWCFRVCYRGICYRRCR*	<u>109</u>	Nakamura <i>et al.</i> (1988)
	Tachyplesin II	RWCFRVCYRGICYRKCR*	<u>110</u>	Muta <i>et al.</i> (1990)
Thionins	Thionin BTH6	KSCCKDTLARNCYNTCRFAG GSRPVCAGACRCKIISGPKCPS DYPK	<u>111</u>	Bohlmann <i>et al.</i> (1988)
Toxins	Toxin 1	GGKPDLRPCIIPPCHYIPRKP R	<u>112</u>	Schmidt <i>et al.</i> (1992)
	Toxin 2	VKDGYIVDDVNCTYFCGRNA YCNEECTKLKGESGYCQWAS PYGNACYCKLPDHVRTKGPG RCH	<u>113</u>	Bontems <i>et al.</i> (1991)

*Argiolas and Pisano, *JBC* 259:10106 (1984); Argiolas and Pisano, *JBC* 260:1437 (1985); Banerjee and Hansen, *JBC* 263:9508 (1988); Bellamy *et al.*, *J. Appl. Bacter.* 73:472 (1992); Bernheimer and Rudy, *BBA* 864:123 (1986); Bohlmann *et al.*, *EMBO J.* 7:1559 (1988); Bontems *et al.*, *Science* 254:1521 (1991); Bulet *et al.*, *JBC* 266:24520 (1991); Bulet *et al.*, *Eur. J. Biochem.* 209:977 (1992); Bulet *et al.*, *JBC* 268:14893 (1993); Casteels *et al.*, *EMBO J.* 8:2387 (1989); Casteels *et al.*, *Eur. J. Biochem.* 187:381 (1990); Cociancich *et al.*, *BBRC* 194:17 (1993); Creighton and Charles, *J. Mol. Biol.* 194:11 (1987); Csordas and Michl, *Monatsh Chemistry* 101:82 (1970); Diamond